SIDE LIGHT TYPE SURFACE LIGHT SOURCE DEVICE

Patent Number: JP10293202

Publication date: 1998-11-04

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Requested Patent: ☐ JP10293202

Application Number: JP19970115222 19970417

Priority Number(s):

IPC Classification: G02B5/02; F21V8/00; G02F1/1335

EC Classification:

Equivalents: JP3384483B2

Abstract

PROBLEM TO BE SOLVED: To reduce uneven luminance in the vicinity of an incident surface by forming plural grooves extended from an emitting surface to a surface opposed to the emitting surface at least in an area opposed to a point light source at the end face of a plate-like member.

SOLUTION: The grooves 13 having the same shape are repeatedly formed on an incident surface 12A of a light transmission plate 12 emitting illuminating light. The grooves 13 are formed to be extended from the emitting surface 12C to a rear surface 12B, and repeatedly formed all over the incident surface 12A. Furthermore, the groove 13 is formed by smoothly connecting a pair of inclined surfaces 13A and 13B having a plane inclined to the incident surface 12A to a curved surface 13C of circular-arc shape, and further smoothly connected to the adjacent groove having the similar curved surface 14 of circular- arc shape. The optical path of the illuminating light L made incident on the inclined surfaces 13A and 13B forming the groove 13 is bent by the inclined surfaces 13A and 13B and the light L is distributed to both side surfaces of the plate 12. The insufficient quantity of the light L is compensated and the uneven luminance of the emitting surface is reduced on the plate 12.

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(19)日本国特許庁（ＪＰ）　　(12) **公開特許公報**（Ａ）　　(11)特許出願公開番号

特開平10－293202

(43)公開日　平成10年(1998)11月４日

(51)Int.Cl.⁶	識別記号	FI		
G02B　5/02		G02B	5/02	C
F21V　8/00	601	F21V	8/00	601E
G02F　1/1335	530	G02F	1/1335	530

審査請求　未請求　請求項の数４　ＦＤ　（全 9 頁）

(21)出願番号　特願平9－115222

(22)出願日　平成９年(1997)４月17日

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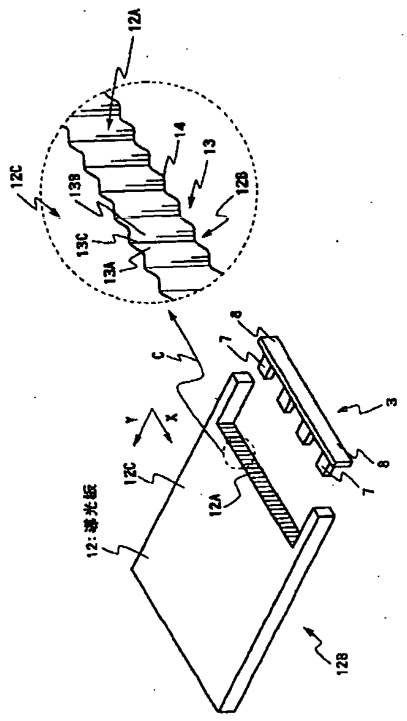
(54)【発明の名称】　サイドライト型面光源装置

(57)【要約】

【課題】サイドライト型面光源装置に関し、発光ダイオード等の点光源を一次光源にしてなるサイドライト型面光源装置に適用して、入射面近傍の輝度ムラを低減する。

【解決手段】本発明は、少なくとも板状部材の点光源７に対向する領域に、出射面１２Ａより裏面１２Ｂに延長する複数の溝１３を形成する。



【特許請求の範囲】

【請求項１】点光源から出射した照明光を板状部材の端面から入射し、前記照明光を屈曲して前記板状部材の出射面より出射するサイドライト型面光源装置において、
前記板状部材は、
少なくとも前記端面の前記点光源に対向する領域に、前記出射面より前記出射面と対向する面に延長する複数の溝を有することを特徴とするサイドライト型面光源装置。

【請求項２】前記溝は、
前記端面に対して斜めに傾いた平面又は曲面による１対の斜面を、曲面により滑らかに接続して形成されたことを特徴とする請求項１に記載のサイドライト型面光源装置。

【請求項３】前記複数の溝は、
前記点光源の中心より遠ざかるに従って深さが順次低減するように形成されたことを特徴とする請求項１又は請求項２に記載のサイドライト型面光源装置。

【請求項４】前記板状部材は、
前記出射面側より見て、前記点光源に対向する領域の全部又は一部が凹状に形成されたことを特徴とする請求項１、請求項２又は請求項３に記載のサイドライト型面光源装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、サイドライト型面光源装置に関し、発光ダイオード等の点光源を一次光源にしてなるサイドライト型面光源装置に適用するものである。本発明は、少なくとも板状部材の点光源に対向する領域に、出射面より裏面に延長する複数の溝を形成することにより入射面近傍の輝度ムラを低減する。

【０００２】

【従来の技術】従来、例えば液晶表示装置においては、サイドライト型面光源装置により液晶表示パネルを照明し、これにより全体形状を薄型化するようになされている。

【０００３】すなわちサイドライト型面光源装置は、一次光源を板状部材（すなわち導光板でなる）の側方に配置し、この一次光源より出射される照明光を導光板の端面より導光板に入射する。さらにサイドライト型面光源装置は、この照明光を屈曲して、導光板の平面より液晶表示パネルに向けて出射し、これにより全体形状を薄型化できるようになされている。

【０００４】このようなサイドライト型面光源装置は、蛍光ランプのような棒状光源により一次光源を構成した方式のものと、発光ダイオードのような点光源により一次光源を構成した方式のものとがあり、後者は、一次光源の駆動回路を簡略化できる等の特徴がある。

【０００５】図１０は、この後者のサイドライト型面光源装置１の一例を示す分解斜視図であり、図１１は、図１０をＡ−Ａ線で切り取って示す断面図である。このサイドライト型面光源装置１は、導光板２の側方に一次光源３を配置し、反射シート４、導光板２、波長変換シート６を順次積層して形成される。

【０００６】一次光源３は、点光源でなる複数の発光ダイオード７をプリント基板等の保持部材８に搭載して形成され、これら発光ダイオード７より出射される照明光を導光板２の端面（以下入射面と呼ぶ）２Ａに入射する。ここで、この種の発光ダイオード７は、矩形形状の樹脂パッケージに封止された、例えば青色の照明光を出射する青色発光ダイオードが適用される。

【０００７】導光板２は、透明部材でなる例えばアクリル（ＰＭＭＡ樹脂）を射出成形して平板形状に形成され、入射面２Ａより一次光源３の照明光を入射する。これにより導光板２は、反射シート４側平面（以下裏面と呼ぶ）２Ｂと波長変換シート６側平面（以下出射面と呼ぶ）２Ｃとの間を繰り返し反射して照明光を伝搬し、この裏面２Ｂ及び出射面２Ｃにおける反射の際に、臨界角以下の成分を裏面２Ｂ及び出射面２Ｃより出射する。

【０００８】さらにこの導光板２は、裏面２Ｂに光散乱面２Ｄが形成される。ここでこの光散乱面２Ｄは、図１２に示すように、入射面２Ａ側より他端に向かって光散乱の程度が順次増大するように、裏面２Ｂを部分的にシボ面に形成して作成される。なお光散乱面２Ｄは、シボ面に代えて例えば炭酸マグネシウム、酸化チタン等を顔料にしてなる光散乱性のインクを選択的に付着して形成される場合もある。より具体的に、光散乱面２Ｄは、一定のピッチ、又はランダムな配置により、例えば矩形形状に梨地面の領域を形成し、入射面２Ａ側より他端に向かって順次各矩形形状領域の面積が増大するように形成される。これにより導光板２は、裏面２Ｂと出射面２Ｃとの間を繰り返し反射して伝搬する照明光を、光散乱面２Ｄにより散乱し、出射面２Ｃに対して臨界角以下の成分を増大する。サイドライト型面光源装置１では、これにより出射面２Ｃから照明光を出射する。

【０００９】反射シート４は、金属箔等でなるシート状の正反射部材、又は白色ＰＥＴフィルム等でなるシート状の乱反射部材により形成され、裏面２Ｂより漏れ出す照明光を反射して導光板２に入射し、これにより照明光の利用効率を向上する。

【００１０】波長変換シート６は、蛍光材を含有するシート材でなり、青色の照明光により蛍光材が励起されて発光することにより、青色の照明光を白色の照明光に補正して射出する。このとき波長変換シート６は、これら白色の照明光を拡散して出射する。これによりサイドライト型面光源装置１では、青色発光ダイオード７による点光源を一次光源にして、出射面２Ｃより白色照明光を出射するようになされている。

【００１１】

【発明が解決しようとする課題】ところでこのようなサ

イドライト型面光源装置1は、入射面に沿って発光ダイオード7より遠ざかると出射光量が低下する欠点がある。これによりサイドライト型面光源装置1は、入射面2Aの近傍、発光ダイオード7間等において輝度レベルの低い領域Bが形成され、入射面近傍で輝度ムラが発生する問題があった。ちなみに従来のサイドライト型面光源装置1においては、これらの領域Bを除く先端側の領域だけを使用することにより、この輝度ムラを回避して高品位の照明光を出射するようになされている。

【0012】これらの領域Bの出射光量を他の領域と同程度に増大することができれば、導光板2の出射面を有効に使用することができ、その分サイドライト型面光源装置を小型化することができる。

【0013】本発明は以上の点を考慮してなされたもので、入射面近傍の輝度ムラを低減することができるサイドライト型面光源装置を提案しようとするものである。

【0014】

【課題を解決するための手段】かかる課題を解決するため本発明においては、点光源から射出した照明光を板状部材の端面から入射し、この照明光を屈曲して板状部材の出射面より出射するサイドライト型面光源装置に適用する。この板状部材が、少なくとも端面の点光源に対向する領域に、出射面より出射面と対向する面に延長する複数の溝を有するようにする。

【0015】このとき、端面に対して斜めに傾いた平面又は曲面による1対の斜面を、曲面により滑らかに接続して、この溝を形成する。

【0016】またこれに代えて又はこれに加えて、点光源の中心より遠ざかるに従って深さが順次低減するように、これら複数の溝を形成する。

【0017】さらにこれらに代えて又はこれらに加えて、出射面側より見て、点光源に対向する領域の全部又は一部が凹状になるように、板状部材を形成する。

【0018】点光源から射出した照明光を板状部材の端面から入射し、この照明光を屈曲して板状部材の出射面より出射するサイドライト型面光源装置において、少なくとも端面の点光源に対向する領域に、出射面より出射面と対向する面に延長する複数の溝を形成すれば、出射面に沿った面内においては、点光源より出射された照明光を両側面側に振り分けて板状部材の内部に導くことができる。また入射面と垂直な面内方向については、照明光が広がらないようにすることができる。これにより入射面に沿った出射面において、点光源近傍について輝度レベルの増大を有効に回避して、点光源より遠ざかった領域の輝度レベルを増大することができる。

【0019】このとき、端面に対して斜めに傾いた平面又は曲面による1対の斜面を、曲面により滑らかに接続してこの溝を形成すれば、斜面により照明光を両側面側に振り分ける際に、この振り分ける量の急激な変化を有回避することができ、斜面の接続部による輝度ムラの発生を有効に回避することができる。

【0020】またこれに代えて又はこれに加えて、点光源の中心より遠ざかるに従って深さが順次低減するように、これら複数の溝を形成すれば、両側面に振り分ける際に、他の溝による反射等を低減して、効率良く側面に振り分けることができる。

【0021】さらにこれらに代えて又はこれらに加えて、出射面側より見て、点光源に対向する領域の全部又は一部が凹状になるように、板状部材を形成すれば、この凹状の部分によっても出射面と平行な面内において照明光を広げることができ、その分効率良く両側面に振り分けることができる。

【0022】

【発明の実施の形態】以下、適宜図面を参照しながら本発明の実施の形態を詳述する。

【0023】（1）第1の実施の形態

図1は、本発明の第1の実施の形態に係るサイドライト型面光源装置に適用される導光板12を一次光源3と共に示す斜視図である。このサイドライト型面光源装置では、この導光板12の裏面12Bに反射シート4を、出射面12Cに波長変換シート6を積層して形成される。なおこの実施の形態に係るサイドライト型面光源装置において、図10について上述したサイドライト型面光源装置1と同一の構成は、対応する符号を付して示し、重複した説明は省略する。

【0024】この導光板12は、透明部材でなる例えばアクリル（PMMA樹脂）を射出成形して平板形状に形成され、入射面12Aより一次光源3の照明光を入射する。これにより導光板12は、裏面12Bと出射面12Cとの間を繰り返し反射して照明光を伝搬し、この裏面12B及び出射面12Cにおける反射の際に、臨界角以下の成分を裏面12B及び出射面12Cより出射する。

【0025】さらにこの導光板12は、裏面12Bに従来と同様の光散乱面が形成され、これにより裏面12Bと出射面12Cとの間を繰り返し反射して伝搬する照明光をこの光散乱面により散乱し、出射面12Cから所望の分布により照明光を出射できるようになされている。

【0026】このようにして照明光を出射する導光板12は、矢印Cにより拡大して示すように、入射面12Aに同一形状の溝13が繰り返し形成されるようになされている。ここでこれらの溝13は、出射面12Cより裏面12Bに延長するように形成され、入射面12Aの全面に繰り返し形成される。なおこの図1及び図2においては、明確化のため溝13を拡大して示す。

【0027】さらに図2に示すように、この溝13は、入射面12Aに対して斜めに傾いた平面による1対の斜面13A及び13Bを円弧形状の曲面13Cにより滑らかに接続して形成され、さらに同様の円弧形状の曲面14により隣接する溝と滑らかに接続されるようになされている。

【００２８】以上の構成において、発光ダイオード７から射出された照明光は（図１）、入射面１２Ａより導光板１２の内部に入射し、この照明光が裏面１２Ｂと出射面１２Ｃとの間で反射を繰り返しながら、導光板１２の内部を伝搬する。このときこの照明光は、裏面１２Ｂで反射する毎に、この裏面１２Ｂに形成された光散乱面２Ｄにより散乱され、その結果増大する出射面１２Ｃに対して臨界角以下の成分が出射面１２Ｃより出射される。このとき照明光は、出射面１２Ｃに配置された波長変換シート６により青色の照明光が白色の照明光に補正される。

【００２９】このようにして発光ダイオード７より導光板１２に入射するにつき、発光ダイオード７より出射される照明光は（図２）、発光ダイオード７の正面方向に向けて鋭い指向性により出射されることにより、その分従来構成のサイドライト型面光源装置１では、入射面に沿って発光ダイオード７より遠ざかると出射面１２Ｃより出射される出射光量が低下し、輝度ムラが観察された。

【００３０】これに対してこの実施の形態においては、入射面１２Ａに形成された溝１３において、この溝１３を形成する斜面１３Ａ及び１３Ｂに入射する照明光Ｌが、それぞれ斜面１３Ａ及び１３Ｂにより光路が折り曲げられ、導光板１２の両側面に振り分けられる。すなわち図２に示すように、発光ダイオード７の正面の溝１３を例に取って示すと、この正面の溝１３によって、領域ＡＲＡ及びＡＲＢに照明光Ｌが振り分けられる。さらにこの正面より両側の溝によって、領域ＡＲＡ及びＡＲＢのさらに外側の領域に照明光Ｌが振り分けられ、これにより導光板１２では、発光ダイオード７間で不足する照明光Ｌの光量が補われて、出射面における輝度ムラが低減される。

【００３１】さらにこのようにして照明光Ｌを振り分ける際に、斜面１３Ａ及び１３Ｂの間に入射した照明光Ｌは、この斜面１３Ａ及び１３Ｂを結ぶ曲面１３Ｃにより光路が折り曲げられ、斜面１３Ａ及び１３Ｂにより照明光Ｌを振り分けた領域ＡＲＡ及びＡＲＢ間の領域ＡＲＭに振り分けられる。このときこの領域ＡＲＭにおいては、斜面１３Ａ及び１３Ｂを曲面１３Ｃにより滑らかに接続していることにより、領域ＡＲＡ、ＡＲＭ、ＡＲＢの境界で急激な照明光Ｌ量の変化を防止することができ、これにより斜面１３Ａ及び１３Ｂの接続部による輝度ムラの発生を有効に回避することができる。かくするにつきこの実施の形態のように、平面による斜面を直接接続して溝を形成すれば、この斜面の接続部に対応する筋状の輝線が出射面より観察され、その分出射光の品位が低下することが分かった。

【００３２】さらに隣接する溝１３の斜面間についても、同様に曲面１４により滑らかに接続されていることにより、この溝１３間に入射する照明光Ｌも溝１３間の境界が目立たなくなるように光路が折り曲げられ、これにより出射光の品位の低下が有効に回避される。

【００３３】以上の構成によれば、出射面１２Ｃより裏面１２Ｂに延長する溝１３を入射面１２Ａに繰り返し形成したことにより、照明光Ｌを導光板１２の両側面に振り分けて導光板１２に入射することができる。これにより発光ダイオード７間で不足する照明光Ｌの光量を補って、入射面１２Ａに沿った輝度ムラを低減することができる。

【００３４】さらにこのとき斜面１３Ａ及び１３Ｂを曲面１３Ｃにより滑らかに接続して溝１３を形成したことにより、斜面１３Ａ及び１３Ｂの接続部による輝度ムラの発生を有効に回避することができ、その分出射光の品位の低下を有効に回避することができる。

【００３５】（２）第２の実施の形態
図3は、図２との対比により溝形状を強調して示す導光板の部分拡大図である。この第２の実施の形態に係るサイドライト型面光源装置では、図１について上述した導光板１２に代えてこの導光板２２が適用される。この導光板２２は、入射面２２Ａの構成を除いて図１について上述した導光板１２と同一に形成され、これにより裏面と出射面との間を繰り返し照明光を反射して伝搬しながら出射面より出射するようになされている。

【００３６】この導光板２２は、発光ダイオード７の出射面に対向する領域に限って同一形状の溝１３が繰り返し形成され、さらにこれら溝が曲面１４により滑らかに接続されるようになされている。

【００３７】図3に示す構成によれば、発光ダイオード７の出射面に対向する領域に限って溝１３を形成するようにしても、第１の実施の形態と同様の効果を得ることができる。また溝１３を発光ダイオード７の出射面に対向する領域に限って形成したことにより、第１の実施の形態に比して導光板２２の金型作成に要する期間を短縮することができる。

【００３８】（３）第３の実施の形態
図4は、図２との対比により溝形状を強調して示す導光板の部分拡大図である。この第３の実施の形態に係るサイドライト型面光源装置では、図１について上述した導光板１２に代えてこの導光板２３が適用される。この導光板２３は、入射面２３Ａの構成を除いて図１について上述した導光板１２と同一に形成され、これにより裏面と出射面との間を繰り返し照明光を反射して伝搬しながら出射面より出射するようになされている。

【００３９】この導光板２３は、入射面２３Ａに溝１３が繰り返し形成され、さらにこれら溝１３が曲面１４により滑らかに接続される。さらにこれら溝１３は、点光源でなる発光ダイオード７の中心に対応する部分で最も深さが深くなり、中心より遠ざかるに従って深さが順次低減するようになされている。

【００４０】これにより導光板２３は、最も入射光量の

大きな発光ダイオード７の中心に対応する部分においては、溝１３を構成する１対の斜面により折り曲げられた照明光Ｌが隣接する溝１３を極力横切らないようにして両側面に振り分け、その分隣接する溝１３を横切ることによる照明光の多重反射を有効に回避して、効率良く照明光を振り分けることができるようになされている。

【００４１】図４に示す構成によれば、発光ダイオード７の中心に対応する部分より遠ざかるに従って深さを順次低減して、入射面２３Ａに複数の溝１３を形成したことにより、第１の実施の形態の効果に加えて、さらに一段と効率良く照明光を振り分けることができ、その分輝度ムラを効率良く低減することができる。

【００４２】（４）第４の実施の形態

図５は、図２との対比により溝形状を強調して示す導光板の部分拡大図である。この第４の実施の形態に係るサイドライト型面光源装置では、図１について上述した導光板１２に代えてこの導光板２４が適用される。この導光板２４は、入射面２４Ａの構成を除いて図１について上述した導光板１２と同一に形成される。

【００４３】この導光板２４の入射面２４Ａは、発光ダイオード７の出射面に対向する領域にだけ溝１３が形成され、これら溝１３は、発光ダイオード７の中心に対応する部分で最も深さが深くなり、中心より遠ざかるに従って順次深さが低減するようになされている。

【００４４】図５に示す構成によれば、発光ダイオード７の出射面に対向する領域にだけ溝１３を形成し、さらにこの溝の深さを、発光ダイオード７の中心に対応する部分より遠ざかるに従って深さを順次低減したことにより、第１の実施の形態の効果に加えて、さらに一段と効率良く照明光を振り分けることができ、その分輝度ムラを効率良く低減することができる。

【００４５】（５）第５の実施の形態

図６は、図２との対比により溝形状を強調して示す導光板の部分拡大図である。この第５の実施の形態に係るサイドライト型面光源装置では、図１について上述した導光板１２に代えてこの導光板２５が適用される。この導光板２５は、入射面２５Ａの構成を除いて図１について上述した導光板１２と同一に形成される。

【００４６】この導光板２５の入射面２５Ａは、発光ダイオード７の出射面に対向する領域が出射面側より見て凹状に形成され、また曲面１４により接続される同一形状の溝１３がこれら凹部２６を含めて繰り返し形成されるようになされている。これにより導光板１２では、両側面側についてだけ照明光Ｌを広げて導光板２５の内部に導くシリンドリカルレンズのレンズ面が凹部２６により形成され、このレンズ面に入射面２５Ａの他の部分と共に、微小な溝１３が形成されるようになされている。

【００４７】図６に示す構成によれば、発光ダイオード７の出射面に対向する領域を出射面側より見て凹状に形成し、入射面２５Ａの他の部分と共に、この凹部２６に微小な溝１３を形成したことにより、さらに一段と効率良く照明光を両側面に振り分けて、輝度ムラを低減することができる。

【００４８】（６）第６の実施の形態

図７は、図２との対比により溝形状を強調して示す導光板の部分拡大図である。この第６の実施の形態に係るサイドライト型面光源装置では、図１について上述した導光板１２に代えてこの導光板２７が適用され、この導光板２７は、入射面２７Ａの構成を除いて図１について上述した導光板１２と同一に形成される。

【００４９】この導光板２７の入射面２７Ａは、発光ダイオード７の出射面に対向する領域が出射面側より見て凹状に形成され、この凹状の部分２６についてだけ同一形状の溝１３が繰り返し形成されるようになされている。

【００５０】図７に示す構成によれば、発光ダイオード７の出射面に対向する領域を出射面側より見て凹状に形成し、この凹部２６に微小な溝１３を形成したことにより、さらに一段と効率良く照明光を両側面に振り分けて、輝度ムラを低減することができる。

【００５１】（７）第７の実施の形態

図８は、図２との対比により溝形状を強調して示す導光板の部分拡大図である。この第６の実施の形態に係るサイドライト型面光源装置では、図１について上述した導光板１２に代えてこの導光板２８が適用され、この導光板２８は、入射面２８Ａの構成を除いて図１について上述した導光板１２と同一に形成される。

【００５２】この導光板２８の入射面２８Ａは、発光ダイオード７の出射面に対向する領域が出射面側より見て凹状に形成され、この凹状の部分２６についてだけ溝１３が繰り返し形成される。さらにこれら溝１３は発光ダイオード７の中心に対応する部分より遠ざかるに従って深さを順次低減して形成されるようになされている。

【００５３】図８に示す構成によれば、発光ダイオード７の出射面に対向する領域を出射面側より見て凹状に形成し、この凹部２６に微小な溝１３を形成し、さらにこの溝の深さを変化させることにより、効率良く照明光を両側面に振り分けて、輝度ムラを一段と低減することができる。

【００５４】（８）他の実施の形態

なお上述の実施の形態においては、単に入射面に溝を形成する場合について述べたが、本発明はこれに限らず、例えばマット面処理、インクの付着等による粗面化処理により、溝を形成した入射面を光拡散面に形成してもよい。このようにすれば、さらに一段と効率良く照明光を両側面に振り分けることができる。

【００５５】さらに上述の実施の形態においては、矩形形状の樹脂パッケージに封止された発光ダイオードにより点光源を構成する場合について述べたが、本発明はこれに限らず、種々の形状の発光ダイオードにより点光源

を構成する場合に広く適用することができる。この場合例えば、上述の第１の実施の形態のように入射面の全面に溝を形成してもよく、また部分的に溝を形成してもよく、さらには溝の深さを変化させてもよい。さらに図９に示すように、例えば先端がドーム形状の発光ダイオード等についても上述の第１～第６の実施の形態に係る導光板を適用することができる。なおこの図９においては、発光ダイオード７Ａの外形形状に対応するように導光板２９に凹部２６を形成し、この凹部２６を含む入射面に溝を形成した場合である。

【００５６】また上述の実施の形態においては、平面でなる斜面を曲面により滑らかに接続して溝を形成する場合について述べたが、本発明はこれに限らず、この斜面を曲面により形成してもよい。

【００５７】また上述の実施の形態では、導光板の裏面にシボ面を形成して光散乱面を形成する場合について述べたが、本発明はこれに限らず、導光板の裏面又は反射シートにインクを付着して光散乱面を形成する場合にも適用することができ、さらには光散乱シート等を配置して光散乱面を形成する場合にも広く適用することができる。

【００５８】また上述の実施の形態においては、点光源として青色の発光ダイオードを使用し、この青色の照明光を出射面の波長変換シートにより白色光に補正する場合について述べたが、本発明はこれに限らず、種々の色彩の点光源を使用して、この点光源の照明光を導光板より直接に出射する場合、又は波長変換シートにより所望の色合いの照明光に変換して出射する場合に広く適用することができる。

【００５９】さらに上述の実施の形態では、一端面より照明光を入射する場合について述べたが、本発明はこれに限らず、併せて他の端面から照明光を入射する構成のサイドライト型面光源装置にも広く適用することができる。

【００６０】さらに上述の実施の形態では、平板形状の板状部材でなる導光板を用いたサイドライト型面光源装置に本発明を適用する場合について述べたが、本発明はこれに限らず、断面楔型形状の導光板を用いたサイドライト型面光源装置にも広く適用することができる。

【００６１】さらに上述の実施の形態では、液晶表示装置の面光源装置に本発明を適用した場合について述べたが、本発明はこれに限らず、種々の照明機器、表示装置等のサイドライト型面光源装置に広く適用することができる。

【００６２】

【発明の効果】上述のように本発明によれば、少なくとも板状部材の点光源に対向する入射面の領域に、出射面より裏面に延長する複数の溝を形成することにより、この領域の照明光を両側面に振り分けることができ、これにより入射面近傍の輝度ムラを低減することができる。

【図面の簡単な説明】

【図１】本発明の実施の形態に係るサイドライト型面光源装置に適用される導光板を示す斜視図である。

【図２】図１の導光板における溝の動作の説明に供する平面図である。

【図３】図２との対比により第２の実施の形態に係るサイドライト型面光源装置に適用される導光板を示す平面図である。

【図４】図２との対比により第３の実施の形態に係るサイドライト型面光源装置に適用される導光板を示す平面図である。

【図５】図２との対比により第４の実施の形態に係るサイドライト型面光源装置に適用される導光板を示す平面図である。

【図６】図２との対比により第５の実施の形態に係るサイドライト型面光源装置に適用される導光板を示す平面図である。

【図７】図２との対比により第６の実施の形態に係るサイドライト型面光源装置に適用される導光板を示す平面図である。

【図８】図２との対比により第７の実施の形態に係るサイドライト型面光源装置に適用される導光板を示す平面図である。

【図９】他の実施の形態に適用される導光板を示す斜視図である。

【図１０】従来のサイドライト型面光源装置を示す分解斜視図である。

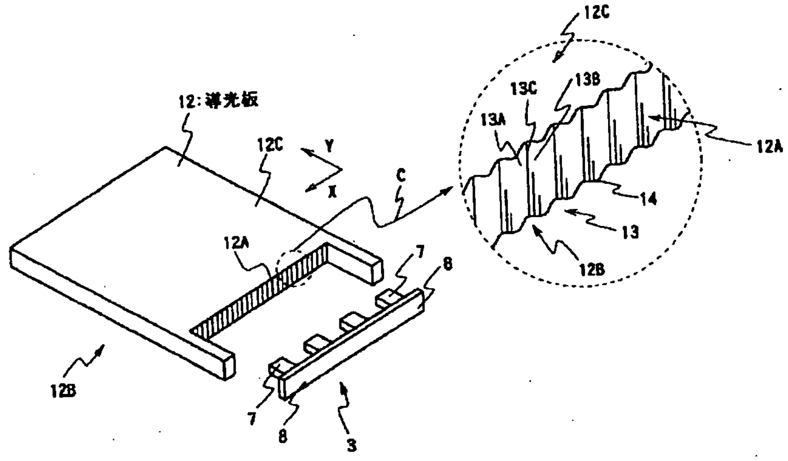
【図１１】図１０をＡ－Ａ線により切り取って示す断面図である。

【図１２】導光板２の裏面を示す平面図である。

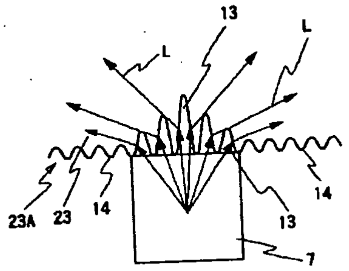
【符号の説明】

１……サイドライト型面光源装置、２、１２、２２～２５、２７～２９……導光板、２Ａ、１２Ａ、２２Ａ～２５Ａ、２７Ａ～２９Ａ……入射面、３……一次光源、４……反射シート、６……波長変換シート、７、７Ａ……発光ダイオード、１３溝、１３Ａ、１３Ｂ……斜面、１３Ｃ、１４……曲面、２６……凹部

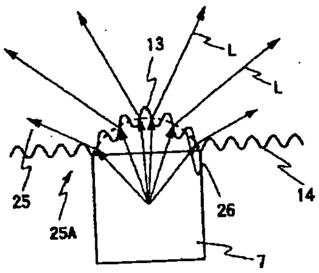
【図1】



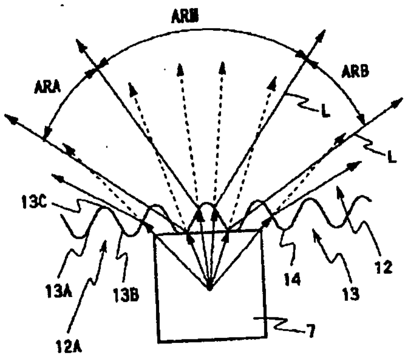
【図4】



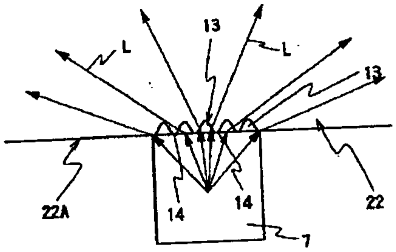
【図6】



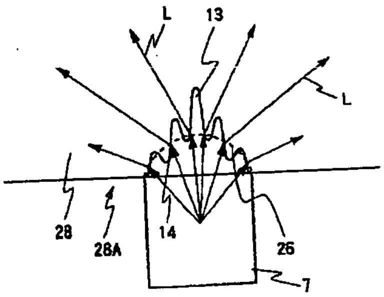
【図2】



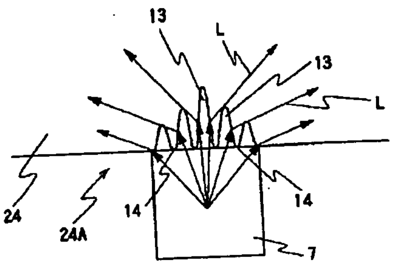
【図3】



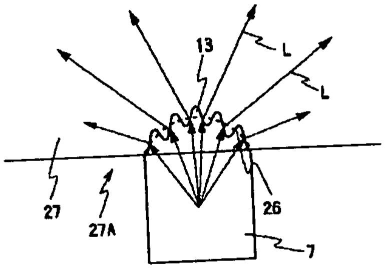
【図8】



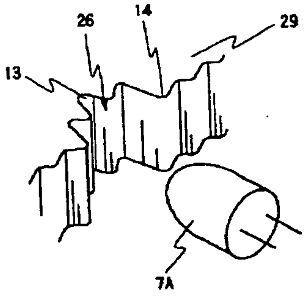
【図5】



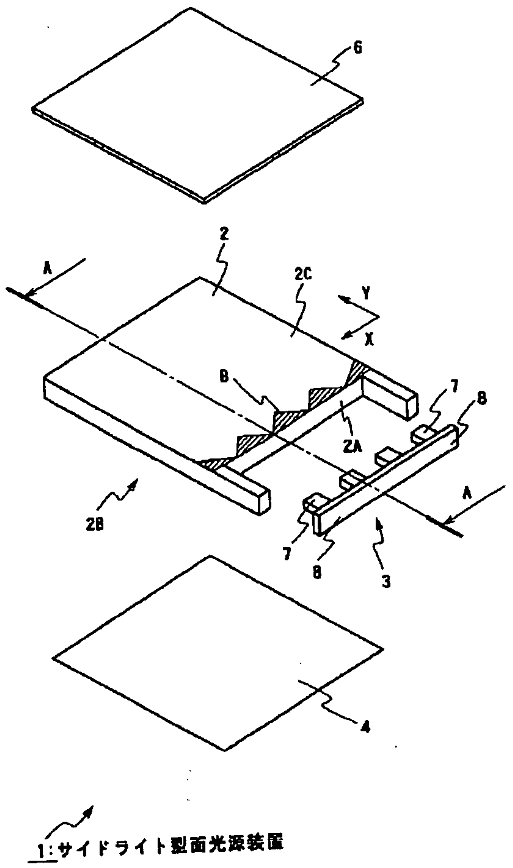
【図7】



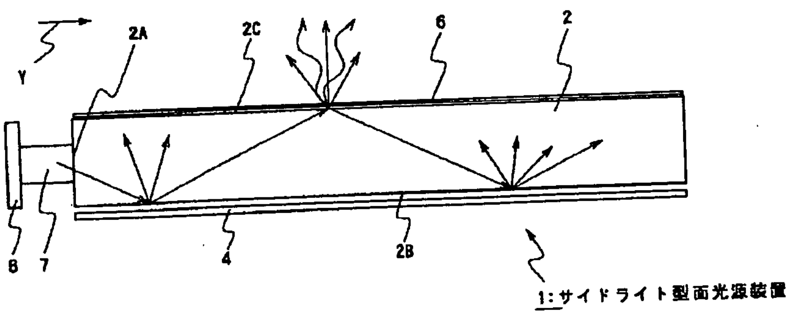
【図9】


7A

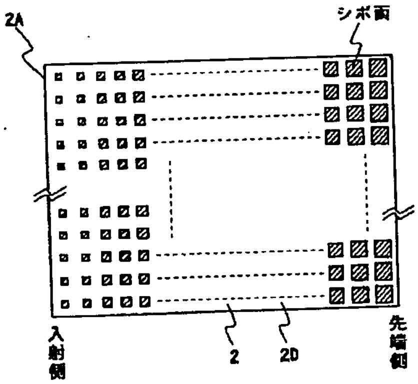
【図10】


6
2
2C
Y
X
A
B
7
8
2A
A
2B
7
8
3
4
1:サイドライト型面光源装置

【図11】


Y
2A
2C
6
2
8
7
4
2B
1:サイドライト型面光源装置

【図12】



PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-293202

(43)Date of publication of application : 04.11.1998

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(51)Int.CI.

G02B 5/02
F21V 8/00
G02F 1/1335

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(21)Application number : 09-115222

(22)Date of filing : 17.04.1997

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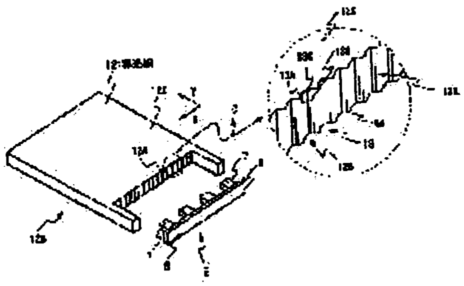
(54) SIDE LIGHT TYPE SURFACE LIGHT SOURCE DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce uneven luminance in the vicinity of an incident surface by forming plural grooves extended from an emitting surface to a surface opposed to the emitting surface at least in an area opposed to a point light source at the end face of a plate-like member.

SOLUTION: The grooves 13 having the same shape are repeatedly formed on an incident surface 12A of a light transmission plate 12 emitting illuminating light. The grooves 13 are formed to be extended from the emitting surface 12C to a rear surface 12B, and repeatedly formed all over the incident surface 12A. Furthermore, the groove 13 is formed by smoothly connecting a pair of inclined surfaces 13A and 13B having a plane inclined to the incident surface 12A to a curved surface 13C of circular-arc shape, and further smoothly connected to the adjacent groove having the similar curved surface 14 of circular- arc shape. The optical path of the illuminating light L made incident on the inclined surfaces 13A and 13B forming the groove 13 is bent by the inclined surfaces 13A and 13B and the light L is distributed to both side surfaces of the plate 12. The insufficient quantity of the light L is compensated and the uneven luminance of the emitting surface is reduced on the plate 12.



LEGAL STATUS

[Date of request for examination] 08.12.2000

[Date of sending the examiner's decision

of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3384483
[Date of registration]	27.12.2002
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

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[JP,10-293202,A]

CLAIMS

[Claim(s)]

[Claim 1] It is side light type surface light source equipment characterized from the aforementioned outgoing-radiation side by to have two or more slots which extend in the aforementioned outgoing-radiation side and the field which counters to the field to which the aforementioned plate-like part material counters the aforementioned point light source of the aforementioned end face at least in the side light type surface light source equipment which carries out incidence of the lighting light which carried out outgoing radiation from the point light source from the end face of plate-like part material, is crooked and carries out the outgoing radiation of the aforementioned lighting light from the outgoing-radiation side of the aforementioned plate-like part material.

[Claim 2] The aforementioned slot is side light type surface light source equipment according to claim 1 characterized by having connected smoothly one pair of slant faces by the flat surface or curved surface which inclined aslant to the aforementioned end face by the curved surface, and being formed.

[Claim 3] Two or more aforementioned slots are side light type surface light source equipment according to claim 1 or 2 characterized by being formed so that the depth may decrease one by one as it keeps away from the center of the aforementioned point light source.

[Claim 4] The aforementioned plate-like part material is the claim 1 characterized by having seen from the aforementioned outgoing radiation side side, and forming in a concave all or some of field which counters the aforementioned point light source, and side light type surface light source equipment according to claim 2 or 3.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention applies the point light sources, such as light emitting diode, to the side light type surface light source equipment which it comes to make into the primary light source about side light type surface light source equipment. this invention reduces the brightness nonuniformity near the plane of incidence by forming two or more slots extended at the rear face from an outgoing radiation side in the field which counters the point light source of plate-like part material at least.

[0002]

[Description of the Prior Art] In the former, for example, a liquid crystal display, a liquid crystal display panel is illuminated with side light type surface light source equipment, and it is made as [ize / thin-shape-/ a whole-configuration / this].

[0003] That is, side light type surface light source equipment arranges the primary light source to the side of plate-like part material (that is, it becomes with a light guide plate), and carries out incidence of the lighting light by which outgoing radiation is carried out from this primary light source to a light guide plate from the end face of a light guide plate. Furthermore, side light type surface light source equipment is crooked, carries out outgoing radiation of this lighting light towards a liquid crystal display panel from the flat surface of a light guide plate, and is made as [carry out /-izing of the whole configuration / thin shape / by this].

[0004] Such side light type surface light source equipment has the thing of the method which constituted the primary light source with the cylindrical light source like a fluorescent lamp, and the thing of the method which constituted the primary light source by the point light source like light emitting diode, and the latter has the feature of being able to simplify the drive circuit of the primary light source.

[0005] Drawing 10 is the decomposition perspective diagram showing an example of the side light type surface light source equipment 1 of this latter, and drawing 11 is the cross section cutting off and showing drawing 10 by the A-A line. This side light type surface light source equipment 1 arranges the primary light source 3, carries out the laminating of the reflective sheet 4, a light guide plate 2, and the wavelength conversion sheet 6 to the side of a light guide plate 2 one by one, and is formed in it.

[0006] The primary light source 3 carries two or more light emitting diodes 7 which become by the point light source in the attachment components 8, such as a printed circuit board, is formed, and carries out incidence of the lighting light by which outgoing radiation is carried out from these light emitting diodes 7 to end-face (it is called plane of incidence below) 2A of a light guide plate 2. Here, this kind of light emitting diode 7 was closed by the resin package of a rectangle configuration, for example, the blue light emitting diode which carries out outgoing radiation of the blue lighting light is applied.

[0007] A light guide plate 2 carries out injection molding of the acrylic (PMMA resin) which becomes by the transparent member, is formed in a monotonous configuration and carries out incidence of the lighting light of the primary light source 3 from plane-of-incidence 2A. More nearly thereby than rear-face 2B and outgoing radiation side 2C, a light guide plate 2 repeats between reflective sheet 4 side flat-surface (it is called rear face below) 2B and wavelength conversion sheet 6 side flat-surface (it is called outgoing radiation side below) 2C, reflects, spreads lighting light, and carries out outgoing radiation of the component below a critical angle in the case of the reflection in this rear-face 2B and outgoing radiation side 2C.

[0008] Furthermore, as for this light guide plate 2, light-scattering side 2D is formed in rear-face 2B. As shown in drawing 12 , rear-face 2B is partially formed in a crimp side, and this light-scattering side 2D is created here so that the grade of light scattering may increase one by one toward the other end from the plane-of-incidence 2A side. In addition, light-scattering side 2D adheres alternatively and the ink of the light-scattering nature which replaces with a crimp side, for example, comes to make a magnesium carbonate, titanium oxide, etc. into a pigment may be formed. More concretely, light-scattering side 2D is formed so that the field of a crepe side may be formed for example, in a rectangle configuration and the area of each rectangle configuration field may increase one by one toward the other end by the fixed pitch or random arrangement from the plane-of-incidence 2A side. Thereby, light guide plates 2 are scattered about by light-scattering side 2D in the lighting light which repeats between rear-face 2B and outgoing radiation side 2C, and is reflected and spread, and increase the component below a critical angle to outgoing radiation side 2C. Thereby with side light type surface light source equipment 1, outgoing radiation of the lighting light is carried out from outgoing radiation side 2C.

[0009] The reflective sheet 4 is formed of the irregular reflection member of the shape of a sheet which becomes with a mirror reflection member or a white PET film of the shape of a sheet which becomes by the metallic foil etc., and it reflects the lighting light which begins to leak from rear-face 2B, it carries out incidence to a light guide plate 2, and, thereby, it improves the use efficiency of lighting light.

[0010] The wavelength conversion sheet 6 becomes by the web material containing fluorescence material, and amends and injects a blue lighting light in a white lighting light by fluorescence material's being excited by blue lighting light and emitting light. At this time, the wavelength conversion sheet 6 diffuses and carries out outgoing radiation of these white lighting light. Thereby with side light type surface light source equipment 1, it is made as [carry out / outgoing radiation of the white lighting light / use the point light source by the blue light emitting diode 7 as the primary light source, and / from outgoing radiation side 2C].

[0011]
[Problem(s) to be Solved by the Invention] By the way, when such side light type surface light source equipment 1 keeps away from light emitting diode 7 along with plane of incidence, it has the fault to which the outgoing radiation quantity of light falls. Thereby, the low field B of an intensity level was formed in between the light emitting diodes 7 near the plane-of-incidence 2A etc., and side light type surface light source equipment 1 had the problem which brightness nonuniformity generates near the plane of incidence. Incidentally it is made as [carry out / outgoing radiation of the high-definition lighting light / avoid this brightness nonuniformity and] by using only the field by the side of the nose of cam except these fields B in conventional side light type surface light source equipment 1.

[0012] If the outgoing radiation quantity of light of these fields B can be increased to the same extent as other fields, the outgoing radiation side of a light guide plate 2 can be used effectively, and the part side light type surface light source equipment can be miniaturized.

[0013] this invention was made in consideration of the above point, and tends to propose the side light type surface light source equipment which can reduce the brightness nonuniformity near the plane of incidence.

[0014]
[Means for Solving the Problem] It applies to the side light type surface light source equipment which carries out incidence of the lighting light injected from the point light source from the end face of plate-like part material in this invention in order to solve this technical problem, is crooked and carries out outgoing radiation of this lighting light from the outgoing radiation side of plate-like part material. It is made for this plate-like part material to have two or more slots extended from an outgoing radiation side to the field which counters the point light source of an end face at least in an outgoing radiation side and the field which counters.

[0015] At this time, one pair of slant faces by the flat surface or curved surface which inclined aslant to the end face are smoothly connected by the curved surface, and this slot is formed.

[0016] moreover, this -- replacing with -- or -- in addition, it keeps away from the center of the point light source -- the slot of these plurality is formed so that it is alike, and it may follow and the depth may decrease one by one

[0017] Furthermore it replaces with these or, in addition to these, sees from an outgoing radiation side side, and plate-like part material is formed so that all or some of field which counters the point light source may become a concave.

[0018] In the side light type surface light source equipment which carries out incidence of the lighting light injected from the point light source from the end face of plate-like part material, is crooked and carries out outgoing radiation of this lighting light from the outgoing radiation side of plate-like part material If two or more slots extended from an outgoing radiation side to an outgoing radiation side and the field which counters are formed in the field which counters the point light source of an end face at least, the lighting light by which outgoing radiation was carried out from the point light source into the field along the outgoing radiation side can be distributed to a both-sides side side, and it can lead to the interior of plate-like part material. Moreover, lighting light can be prevented from spreading about field inboard perpendicular to plane of incidence. In the outgoing radiation side which met plane of incidence by this, increase of an intensity level can be effectively avoided near the point light source, and the intensity level of the field which kept away from the point light source can be increased.

[0019] If one pair of slant faces by the flat surface or curved surface which inclined aslant to the end face are smoothly connected by the curved surface at this time and this slot is formed, in case a slant face will distribute lighting light to a both-sides side side, the abrupt change of this amount to distribute can be avoided effectively, and generating of the brightness nonuniformity by the connection of a slant face can be avoided effectively.

[0020] moreover, this -- replacing with -- or -- in addition, in case [in which it keeps away from the center of the point light source] it will distribute to a both-sides side if the slot of these plurality is formed so that it is alike, and it may follow and the depth may decrease one by one, reflection by other slots etc. can be reduced and it can distribute to the side efficiently

[0021] If plate-like part material is formed so that it may furthermore replace with these, or it may see from an outgoing radiation side side in addition to these and all or some of field which counters the point light source may become a concave, also by this concave portion, lighting light can be extended in a field parallel to an outgoing radiation side, and it can distribute to a both-sides side that much efficiently.

[0022]
[Embodiments of the Invention] Hereafter, the form of operation of this invention is explained in full detail, referring to a drawing suitably.

[0023] (1) Form drawing 1 of the 1st operation is the perspective diagram showing the light guide plate 12 applied to the side light type surface light source equipment concerning the form of operation of the 1st of this invention with the primary light source 3. With this side light type surface light source equipment, the reflective sheet 4 is made rear-face 12B of this light guide plate 12, the laminating of the wavelength conversion sheet 6 is made to outgoing radiation side 12C, and it is formed. In addition, in the side light type surface light source equipment concerning the form of this operation, the same composition as the side light type surface light source equipment 1 mentioned above about drawing 10 attaches a corresponding sign, it is shown and the duplicate explanation is omitted.

[0024] This light guide plate 12 carries out injection molding of the acrylic (PMMA resin) which becomes by the transparent member, is formed in a monotonous configuration and carries out incidence of the lighting light of the primary light source 3 from plane-of-incidence 12A. More nearly thereby than rear-face 12B and outgoing radiation side 12C, a light guide plate 12 repeats between rear-face 12B and outgoing radiation side 12C, reflects, spreads lighting light, and carries out outgoing radiation of the component below a critical angle in the case of the reflection in this rear-face 12B and outgoing radiation side 12C.

[0025] Furthermore, the same light-scattering side as usual is formed in rear-face 12B, and these light guide plates 12 are scattered about according to this light-scattering side in the lighting light which repeats between rear-face 12B and outgoing radiation side 12C by this, and is reflected and spread, and are made as [carry out / the outgoing radiation of the lighting light / from outgoing radiation side 12C / by desired distribution].

[0026] Thus, the light guide plate 12 which carries out outgoing radiation of the lighting light is made as [form / repeatedly / the slot 13 of the same configuration / in plane-of-incidence 12A] so that it may expand with Arrow C and may be shown. These slots 13 are formed so that it may extend from outgoing radiation side 12C to rear-face 12B, and they are repeatedly formed here all over plane-of-incidence 12A. In addition, in this drawing 1 and drawing 2 , a slot 13 is expanded and shown for clarification.

[0027] As furthermore shown in drawing 2 , this slot 13 connects smoothly one pair of slant faces 13A and 13B by the flat surface which inclined aslant to plane-of-incidence 12A by curved-surface 13C of a radii configuration, is formed, and is made as [connect / smoothly / with the slot which adjoins by the curved surface 14 of the still more nearly same radii configuration].

[0028] In the above composition, the lighting light injected from light emitting diode 7 spreads the interior of a light guide plate 12, while incidence is carried out to the interior of a light guide plate 12 and this lighting light repeats reflection between rear-face 12B and outgoing radiation side 12C from (drawing 1) and plane-of-incidence 12A. At this time [C / outgoing radiation side 12], whenever it reflects this lighting light by rear-face 12B, it is scattered about by light-scattering side 2D formed in this rear-face 12B, and outgoing radiation of the component below a critical angle is carried out to outgoing radiation side 12C which increases as a result. At this time, lighting light is amended by lighting light with a blue and white lighting light with the wavelength conversion sheet 6 arranged at outgoing radiation side 12C.

[0029] Thus, in carrying out incidence to a light guide plate 12 from light emitting diode 7, when outgoing radiation was carried out by sharp directivity towards (drawing 2) and the direction of a transverse plane of light emitting diode 7 and the lighting light by which outgoing radiation is carried out from light emitting diode 7 kept away from light emitting diode 7 along with plane of incidence with the side light type surface light source equipment 1 of composition conventionally [the / part], from outgoing radiation side 12C, the outgoing radiation quantity of light by which outgoing radiation is carried out fell, and brightness nonuniformity was observed.

[0030] On the other hand, in the form of this operation, in the slot 13 formed in plane-of-incidence 12A, an optical path is bent by slant faces 13A and 13B, respectively, and the lighting light L which carries out incidence to the slant faces 13A and 13B which form this slot 13 can distribute to the both-sides side of a light guide plate 12. That is, if it is shown taking the case of the slot 13 of the transverse plane of light emitting diode 7 as shown in drawing 2 , the lighting light L can distribute to Fields ARA and ARB by the slot 13 of this transverse plane. Furthermore, from this transverse plane, by the ability of the lighting light L distributing to an outside field further, the quantity of light of the lighting light L of Fields ARA and ARB which runs short between light emitting diodes 7 in a light guide plate 12 is compensated by the slot on the both sides, and, thereby, the brightness nonuniformity in an outgoing radiation side is reduced.

[0031] In case it does still in this way and the lighting light L is distributed, an optical path is bent by curved-surface 13C which connects these slant faces 13A and 13B, and the lighting light L which carried out incidence among slant faces 13A and 13B can be distributed to the field ARM between the fields ARA and ARB which distributed the lighting light L by slant faces 13A and 13B. At this time, by having connected smoothly slant faces 13A and 13B by curved-surface 13C in this field ARM, a rapid change of the amount of lighting light L can be prevented on the boundary of Fields ARA, ARM, and ARB, and, thereby, generating of the brightness nonuniformity by the Fields ARA, ARM, and ARB can be avoided effectively. When carrying out the direct file connection of slant faces 13A and 13B can be avoided effectively. When carrying out the direct file of the slant face by the flat surface to write and forming the slot like the form of this operation in carrying out, it turns out that the bright line of the shape of a line corresponding to the connection of this slant face is observed from an outgoing radiation side, and the grace of the part outgoing radiation light falls.

[0032] Also about between the slant faces of the slot 13 which furthermore adjoins, when the curved surface 14 connects smoothly similarly, an optical path is bent so that the boundary between slots 13 may stop the lighting light L which carries out incidence between this slot 13 being conspicuous, and, thereby, deterioration of the grace of outgoing radiation light is avoided effectively.

[0033] According to the above composition, by having repeated and formed in plane-of-incidence 12A the slot 13 extended to rear-face 12B from outgoing radiation side 12C, the lighting light L can be distributed to the both-sides side of a light guide plate 12, and incidence can be carried out to a light guide plate 12. The quantity of light of the lighting light L which runs short between light emitting diodes 7 by this can be compensated, and the brightness nonuniformity in alignment with plane-of-incidence 12A can be reduced.

[0034] By having connected smoothly slant faces 13A and 13B by curved-surface 13C furthermore at this time, and having formed the slot 13, generating of the brightness nonuniformity by the connection of slant faces 13A and 13B can be avoided effectively, and deterioration of the grace of the part outgoing radiation light can be avoided effectively.

[0035] (2) Form drawing 3 of the 2nd operation is the elements on larger scale of the light guide plate which emphasizes the shape of a quirk by contrast with drawing 2 , and is shown. With the side light type surface light source equipment concerning the form of this 2nd operation, it replaces with the light guide plate 12 mentioned above about drawing 1 , and this light guide plate 22 is applied. This light guide plate 22 is formed identically to the light guide plate 12 mentioned above about drawing 1 except for the composition of plane-of-incidence 22A, it repeats between a rear face and outgoing radiation sides by this, and it is made as [carry out / outgoing radiation / from an outgoing radiation side], reflecting and spreading lighting light.

[0036] Only within the field which counters the outgoing radiation side of light emitting diode 7, the slot 13 of the same configuration is formed repeatedly, and this light guide plate 22 is made as [connect / smoothly / by the curved surface 14 / these slots / further].

[0037] According to the composition shown in drawing 3 , even if it forms a slot 13 only within the field which counters the outgoing radiation side of light emitting diode 7, the same effect as the gestalt of the 1st operation can be acquired. moreover, the thing for which the slot 13 was formed only within the field which counters the outgoing radiation side of light emitting diode 7 -- the gestalt of the 1st operation -- comparing -- the metal mold of a light guide plate 22 -- the period which creation takes can be shortened

[0038] (3) Form drawing 4 of the 3rd operation is the elements on larger scale of the light guide plate which emphasizes the shape of a quirk by contrast with drawing 2 , and is shown. With the side light type surface light source equipment concerning the form of this 3rd operation, it replaces with the light guide plate 12 mentioned above about drawing 1 , and this light guide plate 23 is applied. This light guide plate 23 is formed identically to the light guide plate 12 mentioned above about drawing 1 except for the composition of plane-of-incidence 23A, it repeats between a rear face and outgoing radiation sides by this, and it is made as [carry out / outgoing radiation / from an outgoing radiation side], reflecting and spreading lighting light.

[0039] A slot 13 is repeatedly formed in plane-of-incidence 23A, and, as for this light guide plate 23, these slots 13 are further connected smoothly by the curved surface 14. Furthermore, the depth becomes deep most in the portion corresponding to the center of light emitting diode 7 which becomes by the point light source, and these slots 13 are made as [decrease / one by one / the depth] as it keeps away from a center.

[0040] In the portion corresponding to [by this] the center of the light emitting diode 7 with the biggest amount of incident lights in a light guide plate 23 As the slot 13 where the lighting light L bent by one pair of slant faces which constitute a slot 13 adjoins is not crossed as much as possible, distribute to a both-sides side, and the multiple echo of the lighting light by crossing the slot 13 which carries out part contiguity is avoided effectively. It is made as [distribute / lighting light / efficiently].

[0041] the thing which keep away from the portion corresponding to the center of light emitting diode 7 according to the composition shown in drawing 4 and for which it was alike, and it followed, the depth was reduced one by one, and two or more slots 13 were formed in plane-of-incidence 23A -- the effect of the gestalt of the 1st operation -- in addition, lighting light can be distributed efficiently further much more, and the part brightness nonuniformity can be reduced efficiently

[0042] (4) Gestalt drawing 5 of the 4th operation is the elements on larger scale of the light guide plate which emphasizes the shape of a quirk by contrast with drawing 2 , and is shown. With the side light type surface light source equipment concerning the gestalt of this 4th operation, it replaces with the light guide plate 12 mentioned above about drawing 1 , and this light guide plate 24 is applied. This light guide plate 24 is formed identically to the light guide plate 12 mentioned above about drawing 1 except for the composition of plane-of-incidence 24A.

[0043] A slot 13 is formed only in the field which counters the outgoing radiation side of light emitting diode 7, and plane-of-incidence 24A of this light guide plate 24 is made as [decrease / the depth / one by one] as the depth becomes deep most in the portion corresponding to the center of light emitting diode 7 and these slots 13 keep away from a center.

[0044] the thing which form a slot 13 only in the field which counters the outgoing-radiation side of light emitting diode 7, and keeps away this depth of flute from the portion corresponding to the center of light emitting diode 7 further according to the composition shown in drawing 5 and for which it was alike, and it followed and the depth reduced one by one -- the effect of the gestalt of the 1st operation -- in addition, lighting light can distribute efficiently further much more, and the part brightness nonuniformity can reduce efficiently

[0045] (5) Gestalt drawing 6 of the 5th operation is the elements on larger scale of the light guide plate which emphasizes the shape of a quirk by contrast with drawing 2 , and is shown. With the side light type surface light source equipment concerning the gestalt of this 5th operation, it replaces with the light guide plate 12 mentioned above about drawing 1 , and this light guide plate 25 is applied. This light guide plate 25 is formed identically to the light guide plate 12 mentioned above about drawing 1 except for the composition of plane-of-incidence 25A.

[0046] Plane-of-incidence 25A of this light guide plate 25 is made as [form / repeatedly / including these crevices 26 / the slot 13 of the same configuration which the field which counters the outgoing radiation side of light emitting diode 7 sees from an outgoing radiation side side, and is formed in a concave, and is connected by the curved surface 14]. Thereby with the light guide plate 12, it is made as [form / the minute slot 13 / the lens side of the cylindrical lens which extends the lighting light L only about a both-sides side side, and is led to the interior of a light guide plate 25 is formed of a crevice 26, and / in this lens side / with other portions of plane-of-incidence 25A].

[0047] According to the composition shown in drawing 6 , by having seen the field which counters the outgoing radiation side of light emitting diode 7 from the outgoing radiation side side, having formed in the concave, and having formed the minute slot 13 in this crevice 26 with other portions of plane-of-incidence 25A, lighting light can be efficiently distributed to a both-sides side further much more, and brightness nonuniformity can be reduced.

[0048] (6) Gestalt drawing 7 of the 6th operation is the elements on larger scale of the light guide plate which emphasizes the shape of a quirk by contrast with drawing 2 , and is shown. With the side light type surface light source equipment concerning the gestalt of this 6th operation, it replaces with the light guide plate 12 mentioned above about drawing 1 , this light guide plate 27 is applied, and this light guide plate 27 is formed identically to the light guide plate 12 mentioned above about drawing 1 except for the composition of plane-of-incidence 27A.

[0049] Plane-of-incidence 27A of this light guide plate 27 is made as [form / repeatedly / the slot 13 of the same configuration / the field which counters the outgoing radiation side of light emitting diode 7 sees from an outgoing radiation side side, and is formed in a concave, and / only about this concave portion 26].

[0050] According to the composition shown in drawing 7 , by having seen the field which counters the outgoing radiation side of light emitting diode 7 from the outgoing radiation side side, having formed in the concave, and having formed the minute slot 13 in this crevice 26, lighting light can be efficiently distributed to a both-sides side further much more, and brightness nonuniformity can be reduced.

[0051] (7) Gestalt drawing 8 of the 7th operation is the elements on larger scale of the light guide plate which emphasizes the shape of a quirk by contrast with drawing 2 , and is shown. With the side light type surface light source equipment concerning the gestalt of this 6th operation, it replaces with the light guide plate 12 mentioned above about drawing 1 , this light guide plate 28 is applied, and this light guide plate 28 is formed identically to the light guide plate 12 mentioned above about drawing 1 except for the composition of plane-of-incidence 28A.

[0052] The field which counters the outgoing radiation side of light emitting diode 7 looks at plane-of-incidence 28A of this light guide plate 28 from an outgoing radiation side side, it is formed in a concave, and a slot 13 is repeatedly formed only about this concave portion 26. Furthermore, these slots 13 are made as [form / reduce the depth one by one and] as they keep away from the portion corresponding to the center of light emitting diode 7.

[0053] According to the composition shown in drawing 8 , by seeing the field which counters the outgoing radiation side of light emitting diode 7 from an outgoing radiation side side, forming in a concave, forming the minute slot 13 in this crevice 26, and changing this depth of flute further, lighting light can be efficiently distributed to a both-sides side, and brightness nonuniformity can be reduced much more.

[0054] (8) it is the gestalt of other operations -- in the gestalt of above-mentioned operation, although the case where a slot was only formed in plane of incidence was described, this invention may form in the optical diffusing surface the plane of incidence in which the slot was formed, by split-face-ized processing not only by this but for example, mat side processing, adhesion of ink, etc. If it does in this way, lighting light can be efficiently distributed to a both-sides side further much more.

[0055] Furthermore, although the case where the light emitting diode closed by the resin package of a rectangle configuration in the gestalt of above-mentioned operation constituted the point light source was described, this invention can be widely applied, when the light emitting diode of not only this but various configurations constitutes the point light source. In this case, a slot may be formed all over plane of incidence like the gestalt of the 1st operation of a ****, and a slot may be formed partially, and the depth of flute may be changed further. As furthermore shown in drawing 9 , a nose of cam can apply the light guide plate applied to the above-mentioned gestalt of the 1st - the 6th operation also about dome shape-like light emitting diode. In addition, in this drawing 9 , it is the case where formed the crevice 26 in the light guide plate 29 so that it might correspond to the appearance configuration of light emitting diode 7A, and a slot is formed in plane of incidence including this crevice 26.

[0056] Moreover, in the gestalt of above-mentioned operation, although the case where connected smoothly the slant face which becomes at a flat surface by the curved surface, and a slot was formed was described, this invention may form not only this but this slant face by the curved surface.

[0057] Moreover, although the gestalt of above-mentioned operation described the case where formed a crimp side in the rear face of a light guide plate, and a light-scattering side was formed, this invention can be applied, not only this but when adhering ink to the rear face or reflective sheet of a light guide plate and forming a light-scattering side, and when arranging a light-scattering sheet etc. further and forming a light-scattering side, it can be applied widely.

[0058] Moreover, although the blue light emitting diode as the point light source was used and the wavelength conversion sheet of an outgoing radiation side described this blue lighting light to the white light about the amendment case in the gestalt of above-mentioned operation this invention can be widely applied, when using the point light source of not only this but various colors and carrying out outgoing radiation of the lighting light of this point light source directly from a light guide plate, or when changing into the lighting light of a desired tint with a wavelength conversion sheet and carrying out outgoing radiation.

[0059] Furthermore, with the gestalt of above-mentioned operation, although the case where incidence of the lighting light was carried out from an end side was described, this invention is widely applicable not only to this but the side light type surface light source equipment of composition of carrying out incidence of the lighting light from other end faces collectively.

[0060] Furthermore, with the form of above-mentioned operation, although the case where this invention was applied to the side light type surface light source equipment using the light guide plate which becomes by the plate-like part material of a monotonous configuration was described, this invention is widely applicable not only to this but the side light type surface light source equipment which used the light guide plate of a cross-section wedge-action-die configuration.

[0061] Furthermore, with the form of above-mentioned operation, although the case where this invention was applied to the surface light source equipment of a liquid crystal display was described, this invention is widely applicable to side light type surface light source equipments, such as not only this but various lighting devices, display, etc.

[0062]
[Effect of the Invention] As mentioned above, according to this invention, by forming two or more slots extended at the rear face from an outgoing radiation side in the field of the plane of incidence which counters the point light source of plate-like part material at least, the lighting light of this field can be distributed to a both-sides side, and, thereby, the brightness nonuniformity near the plane of incidence can be reduced.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective diagram showing the light guide plate applied to the side light type surface light source equipment concerning the gestalt of operation of this invention.
[Drawing 2] It is the plan with which explanation of operation of the slot in the light guide plate of drawing 1 is presented.
[Drawing 3] It is the plan showing the light guide plate applied to the side light type surface light source equipment applied to the gestalt of the 2nd operation by contrast with drawing 2 .
[Drawing 4] It is the plan showing the light guide plate applied to the side light type surface light source equipment applied to the gestalt of the 3rd operation by contrast with drawing 2 .
[Drawing 5] It is the plan showing the light guide plate applied to the side light type surface light source equipment applied to the gestalt of the 4th operation by contrast with drawing 2 .
[Drawing 6] It is the plan showing the light guide plate applied to the side light type surface light source equipment applied to the gestalt of the 5th operation by contrast with drawing 2 .

[Drawing 7] It is the plan showing the light guide plate applied to the side light type surface light source equipment applied to the gestalt of the 6th operation by contrast with drawing 2 .
[Drawing 8] It is the plan showing the light guide plate applied to the side light type surface light source equipment applied to the gestalt of the 7th operation by contrast with drawing 2 .
[Drawing 9] It is the perspective diagram showing the light guide plate applied to the gestalt of other operations.
[Drawing 10] It is the decomposition perspective diagram showing conventional side light type surface light source equipment.
[Drawing 11] It is the cross section in which cutting off drawing 10 by the A-A line, and showing it.
[Drawing 12] It is the plan showing the rear face of a light guide plate 2.
[Description of Notations]
1 [.. Plane of incidence, 3 / .. The primary light source, 4 / .. A reflective sheet, 6 / .. 7 A wavelength conversion sheet, 7A / .. Light emitting diode, 13 slots 13A, 13B / .. A slant face, 13C, 14 / .. A curved surface, 26 / .. Crevice] .... Side light type surface light source equipment, 2, 12, 22-25, 27-29 .. A light guide plate, 2A, 12A, 22A-25A, 27A-29A

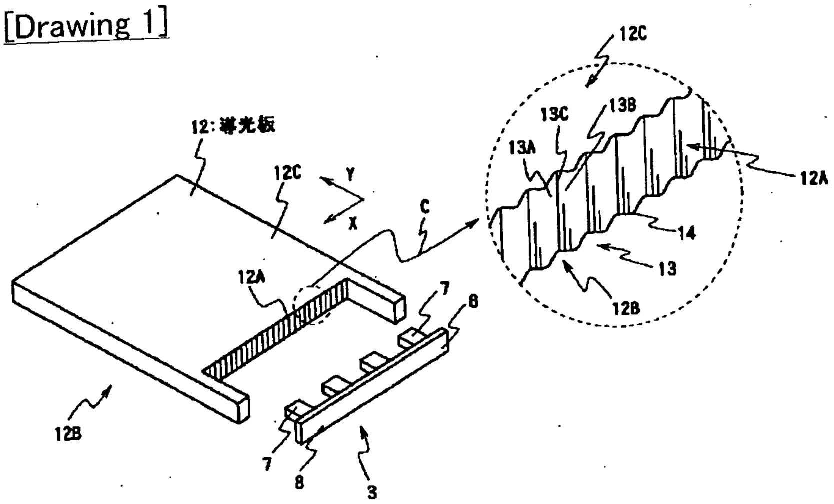
* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

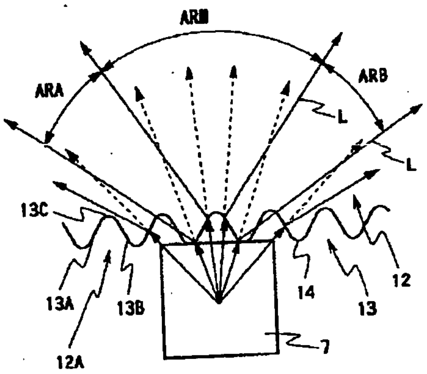
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

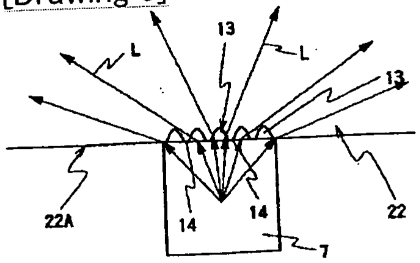
[Drawing 1]



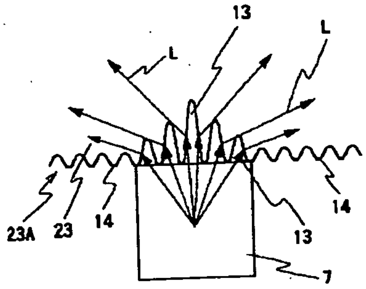
[Drawing 2]



[Drawing 3]



[Drawing 4]



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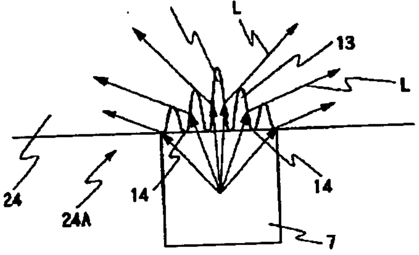
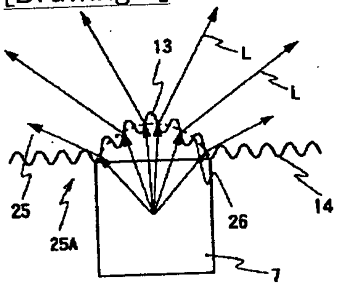
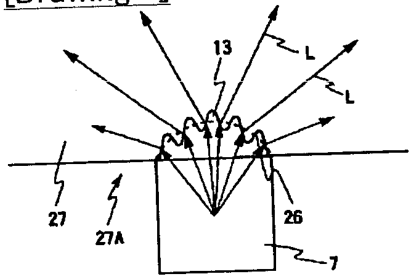


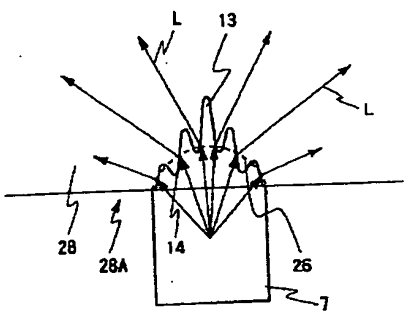
[Drawing 6]



[Drawing 7]



[Drawing 8]



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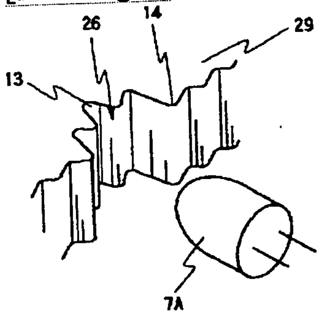
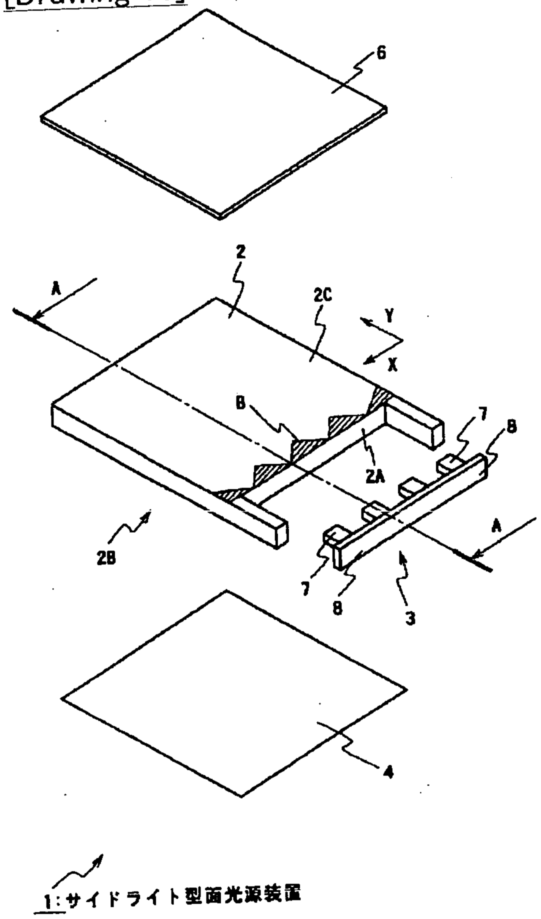
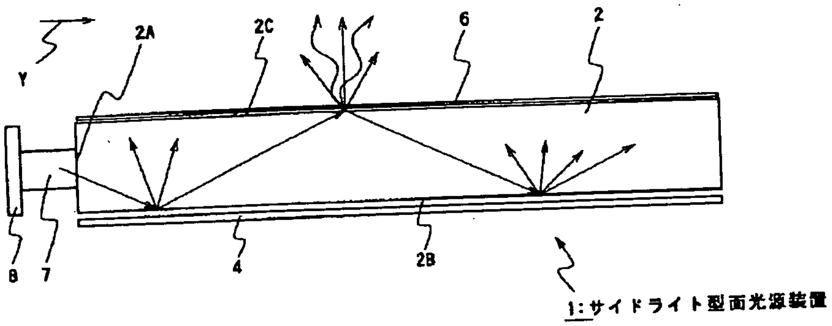


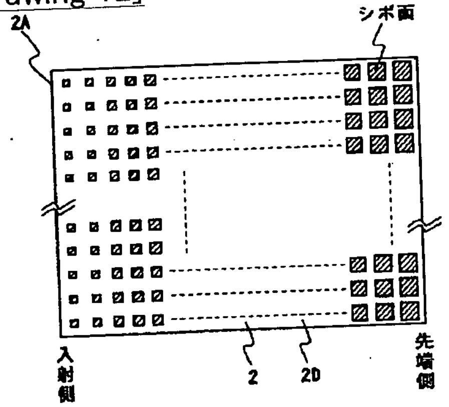
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]